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Home Science

EFFECT OF BULK AND NANO-ZINC OXIDE ON PHYSIO CHANGES IN ROOT LENGTH OF CICER ARIETRIUM (CHICKPEAS).

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ABSTRACT **Introduction:**Zinc oxide nanoparticles are very important due to their utilization in gas sensors, biosensors, cosmetics, drug-delivery systems, and many more. Zinc oxide nanoparticles (ZnO NPs) exhibit remarkable optical, physical, and antimicrobial properties and therefore have great potential to upgrade agriculture. The purpose of these NPs leads to their discharge and growth up in the environment affecting both plants and animals system, which highlight to study the toxicity of both bulk and NPs. **Aim:-**The present study is aimed at investigating the effects of zinc oxide nanoparticles (nano-ZnO) and zinc oxide bulk particles on chickpeas. **Method:-**Four parameters are examined in this study: seed germination percentage, root length, Different concentration (250, 500, 1000 and 2000 mg/L) of ZnONps and ZnO bulk particles were prepared in distilled water and used for the treatment in chickpeas. **Result:-**The results showed that with increase in the concentration of zinc oxide nanoparticles the germination percentage decreases. Thisstudy showed that the use of the zinc oxide nanoparticles and bulk zinc oxide can reduce of the seed germination under controlled condition in comparison with control seed. The present study showed that with increasing the concentration from 250mg/L>500mg/L>1000mg/L>2000mg/L the root length decreases **Conclusion:-**It was concluded that the zinc oxide nanoparticles affect the physiological expression of plant. Nano-ZnO is found to stunt roots length.

KEYWORDS : Phytotoxicity, Nanoparticle, Zinc oxide, Nanotoxicology

INTRODUCTION

Nanotechnology is emerging as the high technological platform for the next wave of development and transformation of agri-food systems. Nanotechnology is attracting large-scale contribution from global food corporations, is backed by academic science, and has captured financial and ideological support from many governments in the world. [1][2] The potential use of nanotechnology are enormous. Nanoparticles (Nano Scale Particles = NSPs) are atomic or molecular aggregates with at least one dimension between 1 and 100nm [3][4], that can drastically change their physio-chemical properties compared to the bulk material

The use of NPs in plant growth and for the control of plant infected disease is a recent practice [7][8]. Nanoparticles fall in the transition zone between separate molecules and the corresponding bulk materials, which generates both positive and negative biological effects in living cell [9] Lu et al. [10]. The effect of mixtures of nano SiO2 and nano TiO2 in soybean seed. They found that the mixture of NPs increases nitrate reductase in soybean increasing its germination and growth and ZnO in growth of Vignaradiataand Cicerarietinumseedlings were using plant agar method [11] and Pea nut [12]. USEPA [13] grouped the engineered nanomaterials into four types: (1) carbon-based materials, generallyincluding fullerene, single walled carbon nanotube (SWCNT) and multi walled carbon nanotube (MWCNT); (2) Metal-based materials such as quantum dots, nano gold, nano zinc (nano-Zn), nano aluminum (nano-Al), and nanoscale metal oxides for eg. TiO2, ZnO and Al2O3; (3) dendrimers, which are nano-sized polymers assembled from branched units capable of being tailored to perform specific chemical functions; and (4) composites, which merge nanoparticles with other nanoparticles or with larger, bulk-type materials.

In this context, it is appearing that some pre sowing seed analysis and exogenous application of ex vivo synthesized nanoparticles (NPs) may beable to alleviate the adverse effect of the abiotic stress on germination [14][15][16]. Between the nanoparticles, nano silica (nSiO2) has gained greater consideration during the last years. Silicon is sufficient in soils and the second most common element on earth after oxygen and has been recognized as animportant nutrient for plant growth and development. A number of researchers have reported the beneficial role of silicon on seed germination and seedling development under stress situation [17][18][19][20]. It show that silicon has a prominent function in plat protection against biotic and abiotic stress [17]. It has been reported that silicon application could alleviate the adverse effects of salinity stress on seed germination [21]and increased water-use efficiency and photosynthesis rate in plants[17].

MATERIALS AND METHODS TEST CHEMICAL

Nano-ZnO were purchased from Nanoshel, Intelligent Materials Pvt. Ltd. Haryana,

India. The Bulk ZnO oxide were purchased from Faridabad, Haryana.
PROPERTIES OF NANO-ZNO (Zn01)

Weight – min 93 %, Alumina – Yes, Amorphous silica – Yes, Specific gravity – 4.0, Bulking valueL/Kg (gal/lb) – 0.25 (0.03), Organic treatment – Yes, Color CIE L* - 99.6, Median particle size – 35-45 mm
NANO-ZNO (NANO-ZNO)

Appearance – white or pale yellow powder, Purity – 99.7%, Grain size – 20-50nm, Specific surface area (m2/g) - >90, Loss on drying - <0.3%, Loss on burning - <0.2%, Pb - ≤0.037%, Mn - ≤0.0001%, Cu - ≤0.0002%.

PREPARATION OF TEST SOLUTION

The bulk and NPs were suspended directly in distilled water and dispersed. For the present study four concentrations viz. 250, 500, 1000 and 2000 mg/L of both bulk and NPs were used and for all experiments freshly prepared solutions were used.

TEST SYSTEM

Commercially available seeds of common peas –were used as the test system.

SEED GERMINATION TEST

The seed germination bioassay was evaluated according to the procedure of EPA. For each analysis triplicate of 50 healthy and uniform size seeds were used. Seeds were surface sterilized with 10% sodium hypochlorite for ten minutes then washed with sterile distilled water and placed on sterile filter paper in the Petri dishes. Fresh test solutions were added to the Petri dishes and the plates were placed in a B.O.D incubator in the dark for 120 h at 25 ± 1°C to facilitate linear growth.

MEASUREMENT OF ROOT LENGTH

For each treatment triplicate of each 50 healthy and uniform size seeds were used. The seeds were sowed in the cups containing sand. Fresh test solutions were added in the cups and kept in the natural environmental for 10 days to grow and subsequently on the 10th day the root lengths.

Statistical analysis

Each experimental was conducted with three replicates, and the results are presented as mean±SE (standard error of the mean). Correlation between the control and treated groups were evaluated by one way ANOVA using SPSS software package and $P<0.05$ was considered as the level of significance and the level of one factor was compared to each level of the other factor by all pairwise multiple comparison procedures (Turkey's test).

RESULTS AND DISCUSSION

Mean score of Root length in differentconcentration of Nano ZnO and bulk ZnO under natural environment condition.

Control sample in water=70±1(mean±SD)

S. No	Dilution	Nanoparticles ZnO (mm)	Bulk ZnO (mm)	F value	p-value
1)	0.25gm/ liter	85±1ac	52±1ab	769.00	0.001*
2)	0.5gm/ liter	83±1ac	41±1ab	1387.00	0.000*
3)	1gm/ liter	70±1c	40±1b	900.00	0.002*
4)	2gm/ liter	61±1ac	24±1ab	1783.00	0.043*

Table 4 revealed the mean score of root length in different concentration of NanoZnO, bulk ZnOand controlled sample.

Root lengthMeasurement- The present study show that the root length was highest in lowest concentration (0.25gm/1litre) of NanoZnO85±1 where as in bulk treated sample show relatively less growth. The root length was significantly increased with the decrease the concentration of NanoZnO and bulk ZnO. The results were statistically significant ($p>0.05$).

DISCUSSION AND CONCLUSION

The present study used different concentration of bulk ZnO and Nano ZnO to assess the root length under controlled condition, germination percentage, root length under natural environment condition in cicerarietrium.

The highest mean score of germination percentage in Nano ZnO, bulk ZnO and controlled sample was indicated at concentration of 0.25gm/liter i.e.96%.

The data for root length indicated that with increasing concentration of Nano particles mean value for root length decreases i.e. 61±1.bulk 24±1 The data for root length was statistically significantly at $p <0.5$ between NanoZnO and bulk ZnO.

The experimental results from the present study showed that Nano particle treated seeds have higher inhibition on the germination percentage, seedling growth, root length than bulk particles. This may be understood by the adherence of Nano ZnO particles to the root surface and inhibiting its morphological growth. Also it can be attributed to the fact that Nano ZnO are insoluble in water and the particles are rapidly lost from solution, probably due to sedimentation as a result of aggregation or sensitivity of the treated test subject. It can be concluded that ZnO NPs does exhibit significant phytotoxicity.

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